

Research Update

Swallow-wort Biological Control Program, USDA-ARS Ithaca, NY



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Pale and black swallow-wort (PSW and BSW; *Vincetoxicum rossicum* and *V. nigrum*, respectively) are European viney milkweeds introduced in the latter-1800s which have become invasive within the last 30 years. They infest a variety of natural and managed habitats.

Potential Biological Control Agents

- Nine insect species and one pathogen have been collected from *Vincetoxicum* spp. in Europe, Siberia and the Russian Far East. Foreign surveys are continuing.
- Preliminary host-range testing has been conducted overseas on the insect species *Abrostola asclepiadis*, *A. clarissa* (defoliating noctuid moths), *Chrysochus asclepiadeus*, *C. chinensis* and *C. goniostoma* (beetles with root-feeding larvae). *Chrysochus* spp. appear to present a risk to some native milkweeds; *Abrostola* spp. appear specific to *Vincetoxicum*.
- *A. clarissa* is now in U.S. quarantine, where we will study its biology and determine its host range using 63 species of test plants.



A. clarissa caterpillar



Adult *A. clarissa*

Collaborators: Margarita Dolgovskaya, Sergey Reznik, Mark Volkovitsh, Vadim Zaitzev (Zoological Institute RAS, St. Petersburg, Russia); Renè Sforza, Walker Jones (USDA-ARS European Biological Control Laboratory, Montferrier sur Lez, France); Dana Berner (USDA-ARS, Ft. Detrick, Maryland); Jianqing Ding (Chinese Academy of Sciences, Wuhan, China)



Typical Swallow-wort forest edge invasion

Weed Biology / Ecology

- Ongoing plant population studies of BSW (field populations) and PSW (field and forest populations) will identify key points in the SW life cycle to be targeted for disruption and thereby guide the selection of effective biological control agents. This is a new approach for weed biocontrol.
 - The identities of North American PSW and BSW have been confirmed by Dr. Gaina Konechnaya and Dr. Nikolai Tselev (Institute of Botany RAS, St. Petersburg, Russia).
 - Both species have much less genetic diversity in North America compared to Europe. Only one major genotype is present in North America for both species - the invasive genotype of PSW is from the Ukraine; BSW origin is currently unknown.
- Thanks to many U.S. and Canadian collectors for your assistance!**
- (-) antofine, a known cytotoxic alkaloid, was identified as the phytotoxin, present in all SW tissues, which greatly reduced seedling root growth in related native species and also had antifungal and antibacterial activity. Lab assays and field soil sampling are planned to confirm active release and determine relevant field concentrations of antofine.

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- PSW invests in an extensive root mass beginning at the seedling stage, whereas BSW typically invests more in shoot growth and reproduction at an earlier age (Milbrath 2008 Botany 86: 1279-1290).

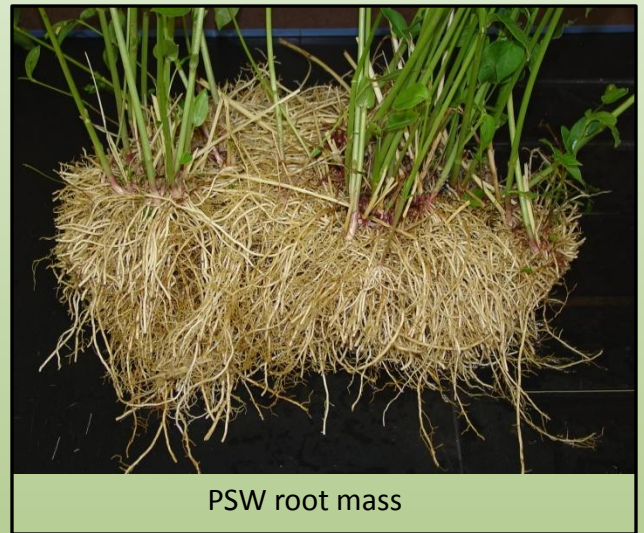
- BSW is clearly a sun-adapted species, with higher photosynthesis rates under high light than PSW. Both species had similar photosynthesis rates in the intermediate light environment of a forest edge. In forest understories, PSW had higher photosynthesis rates than other non-woody plants. BSW is rarely found growing in forests.

- Both SW species have colonized soils with a wide pH range (4.7-8.0).

- PSW seedlings can establish under a range of disturbance regimens, with survival rates up to 84%. In more disturbed plots, plants grew larger and some reproduced in their second season of growth (Averill et al. 2010 Plant Ecology 211: 65-77).

- Clonal expansion (annual increase in stem number) can be high in field-grown BSW and PSW, and both species have comparable annual survival rates (~100%) and seed production rates. Clonal expansion and seed production is much less for forest-grown PSW unless there is good light penetration to the forest floor; survival is still ~100% (Averill et al. 2011 Invasive Plant Science and Management *in press*)

- Few insects or mites in North America attack introduced SW (Milbrath 2010 Environmental Entomology 39: 68-78).



- Six-year field study is in progress using repeated artificial defoliation or clipping on PSW and BSW growing in an open field (without plant competition). After two years, clipping 4x per season was the only type of damage that consistently reduced most, but not all, reproductive and growth parameters.

- As part of the ongoing long-term field monitoring for this project, three years of pre-release PSW density data and two years of plant community data have been collected.

Collaborators: Adam Davis (USDA-ARS, Urbana, IL); Antonio DiTommaso, Scott Morris, Chuck Mohler, and former M.S. students Kristine Averill and Lillian Magidow (Cornell Univ.); Marie-Claude Bon, Renè Sforza (EBCL); M. Dolgovskaya, S. Reznik, M. Volkovitsh (Russia); Stephen Darbyshire (Agriculture and Agri-Food Canada, Ottawa, Ontario)

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